'Florida XP-7': A Yellow *shrunk* 2 Sweet Corn Hybrid and the Male Inbred Parent 'UFISH 8008'

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The fresh-market sweet corn (*Zea mays* L.) crop in southern Florida is concentrated on the muck soils south of Lake Okeechobee in Palm Beach County between 26° and 27°N lat. and at elevations below 15 m. Annual production ranges from 8,000 to 12,000 ha and comprises nearly half of state sweet corn production. The Florida sweet corn industry is based primarily on the *shrunk* 2 (*sh2*) endosperm gene and the crop is used exclusively for fresh-market consumption. Planting begins in late December with the first harvests in mid- to late March. The harvest season is usually completed by late May. This early spring production environment is typical of a tropical dry season, but cold fronts are often responsible for two to five frosts or freezes annually. A second and smaller production period occurs in the autumn, during the hurricane/rainy season.

Diseases such as northern corn leaf blight (NCLB) [*Exserohilum turcicum* (Pass.) Leonard & Suggs] and common rust (*Puccinia sorghi* Schw.) are most common in the spring production season, while southern corn leaf blight (SCLB) [*Bipolaris maydis* (Nisik) Shoemaker] is more prevalent in the autumn (Kucharek and Raid, 1994). The most damaging insect species in southern Florida are the fall armyworm (*Spodoptera frugiperda* J.E. Smith, Lepidoptera: Noctuidae) and the silk fly (*Euxesta stigmatis* Loew., Diptera: Otitidae). These insects infest the sweet corn crop more severely in late summer and late spring. In addition, abiotic stress requires growers to consider problems associated with fertility,

nutrient-use efficiency, periodic flooding, and adaptation to daylengths.

The purpose of this breeding program was to develop a yellow sweet corn hybrid adapted to late winter production, with superior quality and acceptable yield following sugarcane (*Saccharum officinarum* L.). One consequence of early season planting, or rotation behind agro-nomic crops, is the failure of many current hybrids to fully develop kernels of acceptable quality at the tip of the ear. The ability of a hybrid to achieve "tip-fill" is important if the product is to command a premium market price. Inadequate tip-fill is one of the more sensitive manifestations of either abiotic or biotic stress, and is typically induced by disease, low fertility, or extremes in temperature or water supply. Improvement of this trait would allow the Florida grower to more consistently ship a high-quality crop.

Origin

'Florida XP-7' is a *shrunk* 2 (*sh2*) hybrid between the line cross FAHT 32b x FAHT 32c (FaHt 32bxc), and the male parent 'UFISH 8008'. FAHT 32b and FAHT 32c are selected versions of the inbred 'Florida 32' (Wolf, 1975), with *Ht1* conditioned resistance to races 0, 23, and 23N of NCLB. The male parent was developed by pedigree breeding from the cross between 'FA 56a', a derivative of 'Florida 56' (Wolf, 1975) and 'CRSH2-8a'. 'Florida 32' and 'Florida 56' are *sh2* backcross conversions of the standard *sugary 1* (*su1*) inbreds 'Ia 2132' and 'Ia 2256', respectively (Gerdes et al., 1993; Tracy, 1994). 'CRSH2-8a' is a proprietary inbred of the Crookham Co., Caldwell, Idaho. 'UFISH 8008' was developed by single-plant selection for six generations with F_8 seed bulked for test crossing. Each generation was selected under a reduced input regime that included phosphate fertility levels lowered by 30%, no fungicide, and reduced insecticide usage. Specific traits emphasized in the selection of 'UFISH 8008' included the ability to confer improved tip-fill in a hybrid and adaptation for planting and production starting in early to midwinter.

Description

'Florida XP-7'. 'Florida XP-7' was tested in replicated trials at two sites each in Spring

and Autumn 1991 and 1992, and at single sites in Spring 1993 and 1994. All trials were planted in the Everglades Agricultural Area and 'Florida XP-7' was coded as UFY-7. From these trials 30 traits were evaluated by the methods of Kaukis and Davis (1986) and Scully et al. (1994). 'Florida XP-7' is a "mid-season" hybrid averaging 76 days from emergence to prime maturity, and 55 days to mid-silk. It generally matures 1 day later than the standard yellow hybrid 'SS 7210'. Tassel and silk expression are synchronized in 'SS 7210', but silking is delayed 1 day after pollen shed in 'Florida XP-7'. 'Florida XP-7' averages 192 cm in height with the butt of the top ear placed 50 cm aboveground. Compared to 'SS 7210', plants of 'Florida XP-7' are 15 cm taller with the top ear placed 8 cm higher on the stalk. The frequency of second ears averages 47% compared to 15% for 'SS 7210'. Second ear development ranges from rudimentary to complete by the time of top ear maturity and appears to be a function of fertility, season, and stand density. Unexpectedly, the autumn trials produced more second ears for both hybrids. At standard densities, 'Florida XP-7' develops tillers that average 22 cm in height on ~14% of the plants, twice as many as on 'SS 7210'. Brace root development on 'Florida XP-7' is minimal.

At anthesis, the tassels on 'Fla.-XP-7' are light green with yellow anthers and light yellowish green glumes, with an overall length ranging from 28 to 40 cm. The central tassel spike reaches 27 cm, while the 14 to 21 secondary tassel branches are commonly 14 to 18 cm long, nonpendulent, rarely forked, and held at a 15° to 45° angle from vertical. Tassel branches are mostly 1.0 cm wide, while the peduncle subtending the tassel is 7 to 9 mm wide and ~15 cm long. Silks of 'Florida XP-7' extrude up to 13 cm beyond the channel tip, and have a pale, light yellowish green tint. The ear and husk morphology of 'Florida XP-7' is similar to that of 'SS 7210' and the standard bicolor hybrids 'SS 8102' and 'SS 8202' (Table 1, Fig. 1). The leaf at the top ear ranges from 70 to 85 cm long and 9 to 10 cm wide. Across the length of the leaf, there are three to five marginal waves with an amplitude of 4 to 5 cm, and no longitudinal creases. Leaf angle above the top ear averages 45° from vertical with the distal third of the leaf pendulent. Generally, there are five to eight leaves from the node subtending the tassel to the top ear, with very pale pubescence on the leaf sheath.

'Florida XP-7' is superior to 'SS 7210', 'SS 8102', and 'SS 8202' for the percentage of ears with incompletely filled tips, and for a shorter cob tip length with unfilled kernels (Table 1). It also has a significantly wider ear and shorter shank than the two bicolor standards (Table 1). To compensate for inferior appearance in a tray pack, packers must cut off the tip, shank, or both before marketing. 'Florida XP-7' with its lower defect rate requires less postharvest manipulation.

'Florida XP-7' has also been compared to the standard hybrids for response to the common plant diseases found in Florida (Kucharek and Raid, 1994). Based on the 0 to 5 visual

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Table 1. Ear trait means for 'Florida XP-7' compared to the standard commercial yellow hybrids 'SS 7210' and two common commercial bicolor hybrids 'SS 8102' and 'SS 8202', across 10 site/year environments in the Everglades Agricultural Area from 1991 to 1994.^z

Trait	Hybrid				LSD _{0.05}
	SS 7210	Fla. XP-7	SS 8102	SS 8202	
Ear length (cm)	18.6	17.7	19.0	17.9	0.4
Minimum ear length (cm)	17.2	16.3	18.2	16.8	0.7
Maximum ear length (cm)	19.8	17.8	20.0	19.1	0.9
Ear width (cm)	4.7	4.9	4.5	4.6	0.4
Tip blanking (%)	62.3	5.9	9.1	49.6	10.1
Length of unfilled tip (cm)	2.1	0.3	0.6	1.4	0.5
Majority row count	16–18	16–18	14–16	14–16	---
Minimum row count	14	14	12	12	---
Maximum row count	20	20	18	18	---
Husk extension (cm)	4.8	4.8	4.3	4.3	0.8
Extruded tips (%)	0.0	0.1	0.1	0.3	0.3
Shank length (cm)	3.4	3.0	4.7	5.6	0.9
Flag length (cm)	8.6	10.1	10.5	14.1	1.7

^zTrials at each site were a standard randomized complete-block design with three or four replications of each test hybrid. Experimental units were configured as three row plots with two guard rows and a central data row of dimension 0.91 × 9.0 m.

Fig. 1. Husked and green snapped ears of 'Florida XP-7'. Courtesy of Luis Pope Farms (ruler is 30 cm long).

Table 2. Mean yield and disease resistance of 'Florida XP-7' compared to the standard commercial yellow hybrid 'SS 7210' and two common commercial hybrids 'SS 8102' and 'SS 8202' in the Everglades Agricultural Area from 1991 to 1994.^z

Trait	Hybrid				LSD _{0.05}
	SS 7210	Fla. XP-7	SS 8102	SS 8202	
Yield					
Actual yield (crates/ha)	605	561	623	423	62.12
Expected yield (crates/ha)	865	892	860	815	42.87
Plants/ha	51917	52063	51626	49026	2570
Disease ^y					
Northern corn leaf blight	2.0	2.2	2.1	3.9	0.3
Southern corn leaf blight	1.1	1.6	0.6	1.7	0.5
Common rust	2.9	3.7	2.9	2.4	0.5
Bacterial leaf blight	2.4	2.4	2.8	3.0	1.1

^zTrials at each site were a standard randomized complete-block design with three or four replicates of each test hybrid. Experimental units were configured as three row plots with two guard rows and a central data row of dimension 0.91 × 9.0 m.

^yRatings are based on a 0 to 5 visual rating scale with 0 inferring resistant, or the absence of disease, and 5 indicating susceptibility.

disease rating scales modified from Elliot and Jenkins (1940) and Ulstrup et al. (1945), only 'SS 8202' was significantly more susceptible to NCLB (Table 2). Using this same scale, 'Florida XP-7' and 'SS 8202' had a similar response to SCLB and were more susceptible than either 'SS 7210' or 'SS 8102'. Florida has races 0, 1, 23, and 23N of NCLB (Leonard et al., 1989; Pataky et al., 1991) and races O and T of SCLB (R.N. Raid, unpublished data). Resistance to common rust in 'Florida XP-7' was significantly lower than in the three standards, while resistance to bacterial blight incited by *Acitovorax avenae* subsp. *avenae* (formerly: *Pseudomonas avenae*) did not differ significantly from the standards (Table 2). Averaged over the test sites the yield of 'Florida XP-7' is similar to but lower than that of 'SS 7210' or 'SS 8102', but significantly higher than that of 'SS 8202'. There were no differences in expected yield computed on the basis of plant densities, and the anticipated production of a single marketable ear on each plant (Table 2).

Large scale (>1.0 ha) commercial trials across the Everglades Agricultural Area (Table 3) have generally confirmed the results from small plot trials. Growers have reported higher quality for 'Florida XP-7', but lower yields resulting mostly from smaller-sized determinate ears. To improve ear length and subsequent yields of this hybrid, growers regularly apply foliar fertilizers. Although the benefit of this practice is not confirmed for all nutrients, mandated reductions in soil applied fertilizers have increased foliar nutrition programs dramatically in the Everglades Agricultural Area. Additionally, growers confirm that 'Florida XP-7' has a higher frequency of marketable second ears than 'SS 7210', and up to 20% of the marketable second ears are in synchrony with the top ear. Many of the remaining second ears can mature within 1 week of the primary harvest, with additional income generated by the sale of this secondary crop into the peddler market. Commercial harvesters report easy ear detachment and convenient ear height of 'Florida XP-7', which facilitates and speeds harvest.

'UFISH 8008'. In Florida 'UFISH 8008' sheds pollen in 51 to 57 days from planting with silking synchronized or delayed by a single day. It usually tassels and silks 6 to 8 days earlier than 'FA 56a'. In Idaho, where this inbred is used to produce hybrid sweet corn seed, this difference expands, with 'UFISH 8008' and 'FA 56a' flowering in 67 to 69, and 72 to 76 days, respectively. For the production of 'Florida XP-7' seed, 'UFISH 8008' is planted 8 and 12 days after FaHt 32bxc. In the Idaho production fields, plants grow up to 140 cm, but only reach 120 to 130 cm in Florida. Brace roots are mostly absent, but light green when they occur. Stalks have a basal thickness 3 to 5 cm in Idaho and 2 to 4 cm in Florida. Tillers rarely develop. The top ear is set 30 to 35 cm aboveground in Idaho, but only 25 to 30 cm in Florida. Usually, only one ear develops fully, with a second lower ear occasionally expressed, but it rarely matures. Six to eight light-green leaves grow above the

Table 3. Yield and ear quality comparisons of 'Florida XP-7' with adjacent hybrids in commercial trials in the Everglades Agricultural Area from 1993 to 1995.

Cooperator	Farm	Hybrid	Planting date	Harvest date	Crop area (ha)	Previous crop	Yield (crate/ha)	No defects (%)
U.S. Sugar	Runyon #4, K18E	Fla. XP-7	8 Feb. 1993	19 May 1993	4.8	Sugarcane	793	>95
		SS 7630		14 May 1993	14.8		773	>95
	Runyon #17, K18W	Fla. XP-7	19 Feb. 1993	21 May 1993	2.8	Sugarcane	759	>95
		SS 7620	20 Feb. 1993		14.8		798	>95
	Rita, 45-E-11	Fla. XP-7	13 Jan. 1995	20 Apr. 1995	10.9	Sugarcane	788	>95
A. Duda & Sons	State M, Block 2 SS 7710	SS 8102			8.5		613	>95
		Fla. XP-7	8 Feb. 1993	8 May 1993	1.1	Celery ^z	982	94.7
			10 May 1993		9.3		1006	88.5
	State M, Block 7 SS 7210	Fla. XP-7	16 Feb. 1993	17 May 1993	1.1	Celery	585	94.7
					7.2		843	79.4
		Midshipman			1.1		541	---
	State D, Block 7 ACX 92CN12	Fla. XP-7	25 Feb. 1994	7 May 1994	1.1	Celery	582	93.6
					1.1		660	52.0
		Krispy King			1.1		600	85.2
		Monument			1.1		676	92.5
		SS 7630		12 May 1994	6.3		660	87.6

²*Apium graveolens* L. var *dulce* (Mill.) Pers.

top ear, and the leaf angle from vertical range from 30° to 60°, but is mostly 45°. Leaves are pendulant at the distal end. Leaf length averages 75 cm and ranges from 8 to 10 cm wide in Idaho, while in Florida, leaf count and the dimension are decreased, but the leaf angle remains constant. Longitudinal leaf creases are absent, but most leaves have 3 to 5 marginal waves with a 2.0-cm amplitude and a very light sheath pubescence. Leaf morphology is similar to that of 'FA 56a'.

'UFISH 8008' has a tassel morphology similar to that of CRSH2-8a, with light-green glumes, yellow anthers, and light-green tassels. In Idaho, overall tassel length ranges from 19 to 29 cm with a 15- to 19-cm central spike averaging 17 cm and ranging from 9 to 13 mm in width. Peduncle length averages 9 cm from the leaf collar to the tassel base and is 5 mm wide. Tassel branches number 13 to 20, have a mode of 17, with a length and width ranging from 5 to 12 cm and 4 to 9 mm, respectively. In Florida, these dimensions are reduced by 20% to 30%. Tassel branches appear stiff and angle ≥15° from vertical, with light to medium pollen shed. The silk of 'UFISH 8008' is light greenish yellow, and usually extrudes 5 to 10 cm, but occasionally up to 15 cm beyond the silk channel. Husks are light green to green, and when dry become light tan

to buff in color. Ear shank length ranges from 20 to 40 cm and ears are set on the stalk at <30° from vertical. In Idaho, the 10 or more husks extend 6 to 8 cm beyond the ear tip with minimal taper. Most ears have seven to 10 flag leaves that extend up to 28 cm, but more commonly are 15 cm long. Husked ears average 15 × 4 cm with a majority having 14 to 16 rows. Ears occasionally produce a tessellate tip, but tips do not extrude and are rarely blank. Cobs are white, round, straight, typically 2.5 cm in diameter, and easily broken. Seed morphology is typical of a *sh2* yellow fresh-market hybrid.

Availability

'Florida XP-7' is the property of the Florida Agricultural Experiment Station of the Univ. of Florida. It is licensed exclusively to Agrisales, Plant City, Fla., for marketing in Florida, Georgia, and Alabama. Outside this region, Illinois Foundation Seed, Champaign, Ill., has exclusive marketing rights. Use of the inbred 'UFISH 8008' is by contractual arrangement only.

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